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ON THE REPTILIA OF THE KIRTLAND FORMATION OF NEW MEXICO, WITH DESCRIPTIONS OF NEW SPECIES OF FOSSIL TURTLES

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The present paper records the results of a study of a small collection of reptilian specimens in the United States National Museum from the Kirtland formation of New Mexico. It is a third contribution on this subject, as I have considered this fauna in two previous articles (Gilmore, 1916 and 1920). The materials were acquired (1) by a field party from the National Museum working under my direction, which spent the summer of 1929 collecting in the San Juan Basin; (2) by purchase of a small lot of turtles from C. H. Sternberg collected in 1923; and (3) by gifts from individuals or by transfer from the United States Geological Survey of a small but varied assortment of specimens. Study of these shows the presence of several new species of turtles, and other well-preserved specimens contribute to a better understanding of forms previously known.

The recovery of additional though incomplete dinosaurian specmens is of interest in showing the presence of forms other than those previously reported. It is proposed to review briefly those dinosaurian species that are now in other museums but that have been described since the appearance of my 1920 paper. Thus all the new information relating to the extinct vertebrate fauna of the Kirtland formation is brought together in this one article.

DISCUSSION OF GENERA AND SPECIES

Order DINOSAURIA

Since I reviewed the fauna of the Kirtland in 1920, notable advances have been made in our knowledge of the Dinosauria of this period. The discovery of well-preserved specimens has shown the presence of a new genus of the Ceratopsia, of which two species, *Pentaceratops sternbergii* Osborn and *P. fenestratus* Wiman, have been named. The presence of a chasmosaurid ceratopsian appears to be indicated by a fragmentary specimen. The genera *Ceratops* and *Monoclonius*, to which fragmentary specimens have previously been referred as occurring in this formation, should now be dropped from further consideration in that connection. Although it is quite evident that unrecognized ceratopsian genera are present here, better-preserved specimens are necessary before their affinities can be determined. At this time those specimens referred to *Ceratops* and *Monoclonius* have no significance except to indicate the presence of a ceratopsian with fenestrated frills. It is quite possible that some of the specimens so referred in the past may pertain to *Pentaceratops*. The family Hadrosauridae is represented by the two genera *Kritosaurus* and *Parasaurolophus;* the latter is of especial interest, as its first occurrence outside of the Belly River of Canada is now recorded.

The discovery of *Parasaurolophus*, *Gorgosaurus*, and a chasmosaurid dinosaur in the Kirtland formation known elsewhere only in the Belly River is strong evidence in support of the idea of the equivalence in age of these widely separated geological formations.

Family DEINODONTIDAE

GORGOSAURUS species

A specimen (U.S.N.M. no. 8346) collected by Dr. J. B. Reeside, Jr., in 1915, consisting of a left dentary, I described in a previous paper (Gilmore, 1916), but at that time I was unable to identify it. Comparison of this bone directly with a dentary of *Gorgosaurus libratus* Lambe from the Belly River of Canada now shows such close resemblances in size, shape, and other characteristics down to the smallest details as to leave little doubt of their being congeneric. Likewise, the number of alveoli (13) is in agreement with Lambe's (1917) determination from a number of specimens that the dentary in this genus bears 13 or 14 teeth.

Family HADROSAURIDAE

Subfamily HADROSAURINAE

KRITOSAURUS NAVAJOVIUS Brown

Another occurrence of *Kritosaurus navajovius* is recorded by U.S.N.M. no. 8629, consisting of the posterior half of the skull, the left ramus, axis, and third and fourth cervical vertebrae. This specimen was collected by Dr. J. B. Reeside, Jr., in the Kirtland formation, 4 miles southwest of Kimbetoh, San Juan County, N. Mex., in 1916.

It is slightly smaller than the type of the species, but agrees closely with it except in one particular—none of the teeth of the dentary show papillae, but all have smooth borders. The precise number of tooth rows in the dentary cannot be determined from this specimen, although it shows them to be more than 40.

Subfamily LAMBEOSAURINAE

PARASAUROLOPHUS TUBICEN Wiman

PLATE 13, FIGURE 1

The presence of crested hadrosaurians in the Kirtland formation was recognized by me in 1919 on meager materials, but the description of *Parasaurolophus tubicen* by Dr. Wiman (1931) is the first generic recognition of the Lambeosaurinae in these beds. The type specimen, now preserved in the Paleontological Institute of the University of Upsala, Sweden, consists of a partially disarticulated skull, with the posterior half of the characteristic overhanging crest formed by the frontals and premaxillaries, which leaves no uncertainty as to the proper assignment of this specimen. It was collected in San Juan County, N. Mex., in 1921, by C. H. Sternberg.

U.S.N.M. no. 13492, consisting of a posterior half of the right maxillary with teeth, left femur, posterior end of the left ilium, and the almost complete articulated tail. is, on account of the tall spinous processes on the anterior caudal vertebrae, provisionally referred to this same genus and species. This specimen was collected in T. 25 N., R. 13 W., about 6 miles north of Hunter's Store (Bisti P. O.), by N. H. Boss in 1929. The uncertainty of its reference is due to the incompleteness of the specimen on which the genus was established by Parks (1922), which had only the first four vertebrae of the tail present.

Since the National Museum specimen lacks the spinous processes of these particular vertebrae, little of value remains for direct com-

parison. Of the two hadrosaurian genera now known from this formation, *Kritosaurus* may be dismissed from consideration, as the spines on the anterior caudals of a larger individual (Parks, 1929) do not have the elongated proportions of *Parasaurolophus*. The only other possible assignment, so far as known at the present time, is that this tail might pertain to the genus *Hypacrosaurus*, but more diagnostic materials are required to establish such a suggestion. Furthermore, *Hypacrosaurus* is an Edmonton genus, although since it has been recognized in the Two Medicine formation of Montana, no good reason exists why it might not also be found to occur in the Kirtland formation.

The tail shown in plate 13, figure 1, was found articulated and is complete except for the possible loss of a vertebra or two at the distal termination. There are 68 caudal vertebrae present. These were in series with the posterior sacrals of which there are three centra preserved. The posterior end of the left ilium was retained in articulated position, as shown in plate 13, figure 1. All the vertebrae posterior to its hinder border are regarded as caudals. The spinous processes are largely missing on the first six caudals, and the chevrons on all anterior to the tenth. The first complete spine found on the eighth vertebra has a length of 481 mm (about 19 inches). The ninth is 479 mm, and as they become progressively shorter in a posterior direction, the presumption is that the missing anterior spines would progressively increase in length. Based on the progressive rate of change in the known spines it would be a conservative estimate that the first caudal spine would have a height of 516 mm (about 20¼ inches).

Parks gives the length of spines in the first four vertebrae of the type of *Parasaurolophus walkeri* as 415, 410, 400, and 390 mm, respectively. Thus the Kirtland specimen exceeds *P. walkeri* in spine development, although the femur of the latter is slightly longer, measuring 1,032 mm, as compared with 985 mm for the specimen under consideration.

The great dorsoventral depth of the tail is strikingly illustrated by a vertical measurement taken across the fourteenth vertebra. From spine top to chevron tip it measures 31½ inches. The seventh caudal has a spine 375 mm and a centrum 69 mm long; the tenth vertebral centrum is 65 mm long.

There are transverse processes on the first 16 vertebrae, but these are so poorly preserved as to be unworthy of description. As the principal features of this series are clearly set forth in plate 13, figure 1, further description of the tail is unnecessary.

The posterior half of a right maxillary, partly filled with teeth, was found in the block carrying the sacral portion, and it is pre-

sumed to belong to this same individual. The teeth of the functional series are much worn and extend but little below the alveolar border on the internal side. They have smooth borders, with strong median carinae, and none shows evidence of being papillate. In the present state of our knowledge concerning the teeth of the Hadrosauridae, the dentition of this specimen gives no assistance in its identification, especially since the teeth of the contemporary forms have not as yet been adequately illustrated or described.

The left femur preserved with this specimen is in an excellent state of preservation, except for the loss of portions of the head. It is typically hadrosaurian and differs from the femur of *P. walkeri* in having the posterior extremity of the fourth trochanter precisely at mid length, whereas in *P. walkeri* it is well below the middle.

Although this specimen is provisionally referred to *P. tubicen*, it may eventually be found to belong to a form as yet unrecognized in the Kirtland formation.

Family CERATOPSIDAE

PENTACERATOPS STERNBERGII Osborn

PLATE 13, FIGURE 2

The genus *Pentaceratops* was established by Professor Osborn (1923) on a well-preserved skull found by C. H. Sternberg in the Fruitland formation. In 1929, George F. Sternberg collected a nearly complete right squamosal (U.S.N.M. no. 12002) (see pl. 13, fig. 2) in SW.¼, T. 24 N., R. 13 W., San Juan County, N. Mex., from the Kirtland formation, which Lull (1933) identifies as pertaining to this species, thus recording the presence of *P. sternbergii* in the Kirtland formation. A second specimen (U.S.N.M. no. 12743), consisting of a supraorbital horn-core and parts of a squamosal from this same locality and formation, is quite certainly referable to *P. sternbergii*. The horn-core in size, shape, and curvature closely resembles that of the type specimen. The two other known specimens (Amer. Mus. Nat. Hist. nos. 1624 and 1625) are said to have come from the Fruitland formation.

PENTACERATOPS FENESTRATUS Wiman

This species was founded (Wiman, 1930) on a crushed but essentially complete skull, collected by C. H. Sternberg on the north branch of Meyers Creek, 1 mile south of Kimbetoh Wash, San Juan County, N. Mex., from the Kirtland formation. A single fenestra in the squamosal bones distinguishes it from *P. sternbergii* and apparently was the character that suggested the specific name. Lull is

inclined to regard this fenestra as pathologic. A second specimen, consisting of the lower jaw associated with the greater part of the skeleton from Meyers Creek, was also described by Wiman. This material is in the University of Upsala, Sweden.

CHASMOSAURUS species

A supraorbital horn-core (U.S.N.M. no. 12018), collected by N. H. Boss in the Kirtland formation, 5 miles west of Brimhall's Store, San Juan County, N. Mex., in 1929, is provisionally identified as pertaining to the genus *Chasmosaurus*. This identification rests on its close resemblance in form and size to the horn-cores of a skull of *C. belli*, described and figured by Lambe (1915). I am fully aware of the uncertainty of an identification based on such meager evidence, but with our present knowledge of the ceratopsian Dinosauria, the only other possibility is that this specimen might pertain to *Centrosaurus*, although in none of the skulls known to me of this genus do the supraorbital horn-cores closely resemble, except in size, the one before me. In either event the presence of a hitherto unrecognized ceratopsian genus in the Kirtland fauna is indicated.

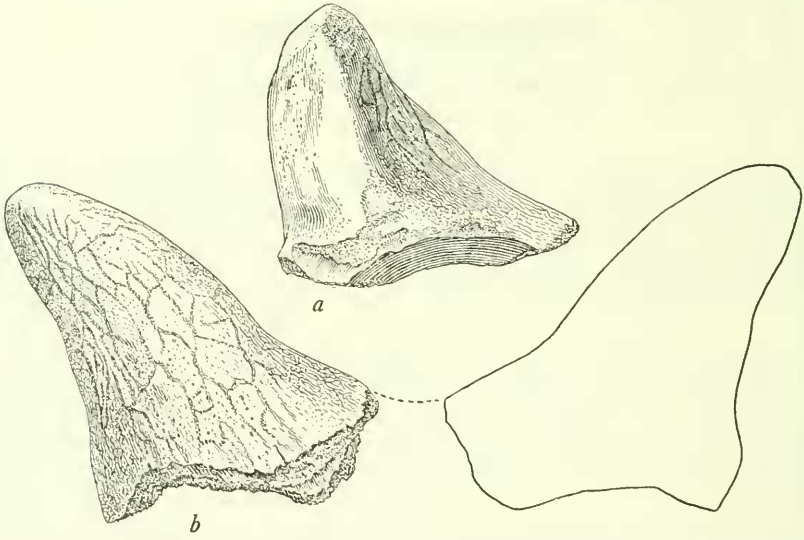

FIGURE 6.—Supraorbital horn-core of a chasmosaurid dinosaur, U.S.N.M. no. 12018: *a*, Lateral view; *b*, posterior view. A little less than one-third natural size.

This horn-core is short, with a bluntly pointed tip and slightly recurved. Broadly oval in cross section near the base with the greatest diameter anteroposteriorly, its broad ventral surface is hollowed and forms the upper boundary of the orbit. The surface of the horn is channeled by the usual series of ramifying canals. It is illustrated in figure 6.

Order CHELONIA

Four families of Chelonia, the Pleurosternidae, Baenidae, Dermatemydidae, and Trionychidae, are now recognized in the Kirtland formation. Eleven species have been named, four of which are herein described as new.

Family PLEUROSTERNIDAE

NEURANKYLUS BAUERI Gilmore

A single specimen (U.S.N.M. no. 13228), collected by the 1929 expedition, is referred to this species. It is considerably larger than the type specimen, the carapace measuring 605 mm in length on the median line, whereas the type is only 560 mm in this dimension. Except for its large size, the specimen contributes little to our knowledge of this species, as most of the sulci and all the sutures are obliterated. It was found by G. F. Sternberg in T. 23 N., R. 10 W., San Juan County, N. Mex., in the Kirtland formation.

Recently, however, Dr. Wiman (1933) has added much to a better understanding of the skeletal anatomy of this species, through the description of four specimens obtained for him in New Mexico in 1921 by C. H. Sternberg. The description of the cervical and caudal vertebrae and of the pelvic and pectoral arches together with a humerus gives the first information of the skeleton aside from the carapace and plastron. These species are said to have come from both the Kirtland and Fruitland formations.

Family BAENIDAE

BAENA ORNATA, new species

FIGURES 7, 8; PLATE 14

Type.—U.S.N.M. no. 13229, consisting of a nearly perfect carapace and plastron. Collected by G. F. Sternberg, June 20, 1929.

Locality.—3 miles northeast of Hunter's Store (Bisti P. O.), SW¼, T. 24 N., R. 13 W., San Juan County, N. Mex.

Horizon.—Kirtland formation, Upper Cretaceous.

Description.—The specimen selected as the type of this species is an unusually well preserved carapace and plastron, lacking only some minor fragments. In outline the carapace is broadly ovate with scalloped borders posterior to the inguinal notches. There is a shallow median indenture in front and a wider and more pronounced emargination of the central posterior border.

At the widest part, about mid length, the carapace measures 437 mm across; its greatest length at the center is 478 mm. The depth

of the shell at the center, the highest point, is about 105 mm, probably more in life, since there is some indication of vertical compression.

The very rough surface ornamentation of the carapace (see pl. 14) is quite characteristic of this species, and this feature alone is sufficient to distinguish it from all described baenids with the possible exception of *Baena nodosa* Gilmore, which also occurs in this same formation.

The ornamentation consists of a series of elongate, longitudinal, round-topped ridges and low, rounded, nodelike protuberances. These are arranged in alternate transverse bands across the mid region of the shell, extending somewhat outside of the vertebral areas, where they are sparser and less regular in their placement. In the type there is a median ridge formed by three and four of these elongated elevations set closely parallel with narrow grooves between. This ridge is not continuous but interrupted at intervals where the transverse bands of rounded nodes cross from one side to the other. In U.S.N.M. no. 12821, which clearly pertains to this species, this ridge is made by a single elevation, although the other sculpture is quite similar to that of the type specimen. The outer half of the costal area and the whole posterior fourth of the shell have an undulating surface, but plain except for a few low scattered nodes. The surface is not smooth but slightly wrinkled, with a shagreened appearance resulting. The peripheral surfaces are fairly smooth, except along the front of the shell, where they are ornamented by low, irregularly shaped elevations.

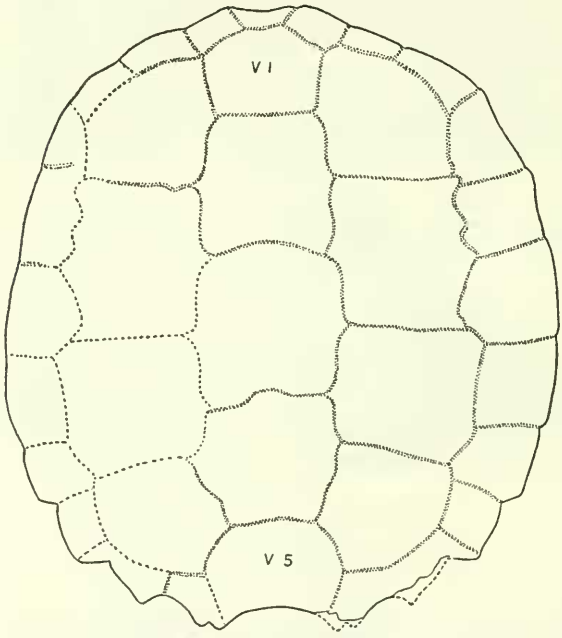

FIGURE 7.—Carapace of *Baena ornata*, new species. Type. U.S.N.M. no. 13229. V1, V5, Vertebrals 1 and 5, respectively. One-sixth natural size.

TABLE 1.—*Measurements of vertebral scutes of* Baena ornata

No.	Length	Width
	Mm	*Mm*
1	68	96
2	103	111
3	115	127
4	106	122
5	72	110

The sulci are plainly impressed, except on the left side. The sutures, however, are entirely obliterated. The nuchal of the type is trapezoidal with the widest side anterior; in a second specimen (U.S.N.M. no. 12821) it is rectangular. It has a length of 14 mm and a greatest width on the free border of 50 mm.

The vertebral scutes are wider than long. Their principal dimensions are given in table 1. The shape of the carapace and the arrangement of the dermal scutes are clearly shown in figure 7.

The emargination on the posterior border is about 95 mm wide. The plastron is completely preserved, but as with the carapace none of the sutures can be traced, and the sulci on the outer parts of the bridge have been obliterated. The median part of the plastron is broadly hollowed out, indicating the male sex of the type specimen. The plastral surface is evenly sculptured by a series of shallow pits, surrounded by low, round-topped ridges. The pits are of irregular shape and size but present a fairly uniform rough-

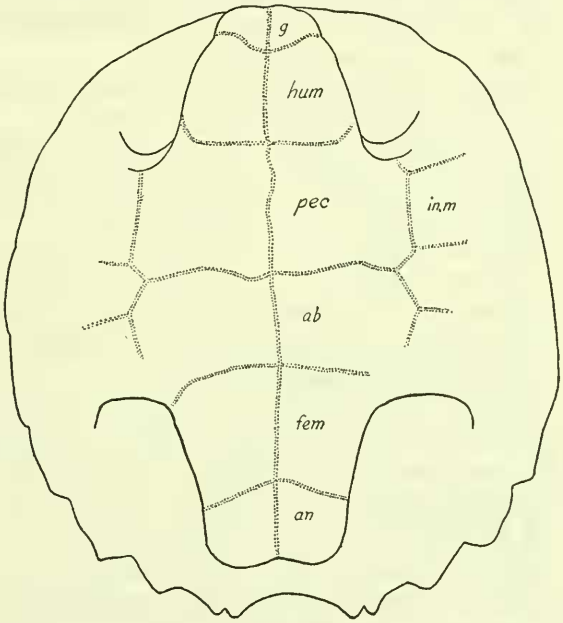

FIGURE 8.—Plastron of *Baena ornata*, new species. Type. U.S.N.M. no. 13229. *ab*, Abdominal; *an*, anal; *fem*, femoral; *g*, gular; *hum*, humeral; *in.m*, inframarginals; *pec*, pectoral scute. About one-sixth natural size.

ening of the entire surface. The plastron as a whole is large. The total length is 440 mm. The anterior lobe has a length of 117 mm and a breadth at its base of 150 mm. From the base the lateral borders run forward and inward, turning inward rather abruptly immediately preceding the junction of the gular-humeral scutes to form a slight notch, as shown in figure 8. The end of the plastron is truncated and is about even with the anterior border of the carapace.

The posterior lobe has a length of 120 mm and a width at the base of 155 mm, and ends forward of the posterior border of the carapace. The posterior end is angularly concave. The bridge has a width of about 205 mm.

Gular scutes are present, but I find no trace of intergulars. The gulars measure 35 mm in length on the mid line; the humerals 73 mm; the pectorals 106 mm; the abdominals 73 mm; the femorals 95 mm; and the anals about 60 mm.

On the bridge there are indications of four large inframarginals lying principally on the plastron bones.

As mentioned previously, the ornate sculpture of *Baena ornata* at once distinguishes this species from all described forms, with the possible exception of *B. nodosa*. From that species it may be distinguished by the more quadrangular form of the shell; greatest transverse diameter at mid length; quadrangular shape of first vertebral and the absence of accessory scutes lateral to the first vertebral; and in having all the vertebrals wider than long.

A second specimen (U.S.N.M. no. 11083) is also identified as belonging to this species. It is larger than the type specimen, and the plane surface of the plastron points to its being a female. This specimen was collected by C. H. Sternberg from the Kirtland formation in the "wash south of Ojo Alamo Wash," 9 miles northeast of Tsaya, San Juan County, N. Mex., in 1923.

The carapace except in front lacks most of its outer rim, but the plastron is complete except for a small portion of the posterior lobe. It has an estimated length of about 510 mm, which indicates the much larger size of this individual, as the plastron of the type measures only 440 mm. The anterior lobe is strongly notched at the junction of the gular-humeral scutes, as in the type. At this point it has a greatest transverse diameter of 93 mm. The lobe is 125 mm long and 183 mm wide at the base. The bridge is 245 mm wide. The posterior lobe is 195 mm wide at the base.

A third specimen (U.S.N.M. no. 12821) may also be clearly referred to this species. It was collected by me in SW¼, T. 24 N., R. 13 W., 3 miles northeast of Hunter's Store, San Juan County, N. Mex., in 1929.

BAENA NODOSA Gilmore

Since *Baena nodosa* was first described in 1916, no less than eight specimens acquired by the National Museum have been identified as pertaining to this species. Four of these have been commented on previously (1920). Two were obtained from C. H. Sternberg, and the other two were collected by the 1929 paleontological expedition. All have the characteristic nodelike ornamentation of the carapace and in most respects are in accord with the type specimen. Two specimens (U.S.N.M. nos. 12819 and 11323) differ from the type in having a more broadly rounded anterior border of the carapace, and no. 11323 also has the nodes more sparsely placed over the surface of the shell. In all other respects these specimens show no discordant features. That the type is not a large example of the species is indicated by the length of the carapace at the center—375 mm, 380 mm, and 403 mm in three individuals—whereas in the type the length is only 354 mm.

U.S.N.M. no. 12819, collected by G. F. Sternberg 3 miles northeast of Hunter's Store, San Juan County, N. Mex., shows that the restored scallops along the rear border of the type specimen as illustrated in my original description are in error. Away from the central ones they become more rounded transversely with shallower indentations between them, instead of being bluntly pointed and having deep emarginations.

A nearly complete but somewhat crushed shell (U.S.N.M. no. 11327) is of interest in confirming the presence of this species in the Fruitland formation. It also records a new locality for the species—Coal Creek, 3 miles southeast of Tsaya, San Juan County, N. Mex.

In the collection made for the University of Upsala by C. H. Sternberg, Wiman (1933) found 17 specimens that he identified as pertaining to *Baena nodosa*. Eight of these are from the Kirtland formation, five from the Fruitland, and four are without designation as to horizon. Wiman calls attention to the great variation in the dermal scuta and in the form of the carapace. He finds none that are precisely in accord with the type of the species. Regardless of the differences found, he concludes that all should be referred to *B. nodosa*, a conclusion with which with one exception I am fully in accord. Specimen no. 9 of his series, in which he regards the lateral and marginal scutes as being wholly abnormal, may possibly pertain to the genus *Boremys*. If this suggestion is correct, it marks the first recorded occurrence of this genus in the Fruitland.

Genus BOREMYS Lambe

The genus *Boremys* was established by Lambe in 1906 for the species *pulchra* previously referred by him to the genus *Baena*. In

1919 I added the species *B. albertensis.* Both of the type specimens were from the Belly River formation, Upper Cretaceous of Alberta, Canada. A specimen about to be described records the first occurrence of this genus outside of Canada.

Hay (1908) characterized the genus as follows:

> Like *Baëna*, but having on each side supramarginal scutes, which alternate with the costal scutes. Nuchal bone short and wide. A preneural present.

I would amend this definition by the addition of the following characters: Five or six vertebrals, last vertebral separated from posterior border by supracaudal scutes. This is a character found among the Baenidae only in *Boremys* and *Thescelus.*

Boremys pulchra: Small size, front of shell broadly rounded; costal scutes wider than long. Five vertebral scutes.

Boremys albertensis: Small size, front of shell bluntly pointed; costal scutes longer than wide. Five vertebral scutes. Anterior lobe of plastron shorter than posterior lobe.

Boremys grandis: Large size, front of shell broadly rounded; costal scutes longer than wide. Six vertebral scutes. Anterior lobe of plastron longer than posterior lobe.

BOREMYS GRANDIS, new species

FIGURES 9, 10; PLATE 15

Type.—U.S.N.M. no. 12979, consisting of a nearly complete carapace and plastron. Collected by George F. Sternberg, 1929.

Type locality.—SW¼, T. 24 N., R. 13 W., 3 miles northeast of Hunter's Store (Bisti P. O.), San Juan County, N. Mex.

Horizon.—Kirtland formation, Upper Cretaceous.

Description.—The specimen selected as the type lacks portions of the lateral borders and is somewhat depressed by vertical crushing. The shell is subquadrangular in outline, being longer than wide, with a broadly rounded anterior end and a truncated posterior border. Its large size at once distinguishes it from known species, as it is more than twice the size of *B. pulchra* and fully twice as large as *B. albertensis.* In this specimen the plastron projects strongly in front of the anterior border of the carapace, as in *Thescelus;* this feature, however, may be in part due to the crushing to which the specimen has been subjected.

The surface of the shell is undulating and is devoid of ornamentation, except for low-lying bosses that are sparsely scattered over the supramarginal and marginal areas. The central part of the carapace is fairly smooth, with slight indication of a median keel fore and aft.

The few anterior neurals that can be traced out have the same shape and relative proportions as those of *B. pulchra*. A preneural is present as in *Chisternon*. The form of these bones is well shown in figure 9. The costals are rather uniform in width so far as they can be determined.

The carapace has a greatest length at the center of 442 mm and a greatest width of 375 mm. The lateral borders posterior to the inguinal notches thin out to a sharp edge that is shallowly and widely scalloped.

The sulci outlining the various scutes are plainly impressed, but along either border, owing to faulty preservation, they can no longer be determined. The presence of supramarginal scutes is clearly shown on the forward half of the carapace (see fig. 9, *s.m.s.*), and the presence of these scutes at once determines the generic affinities of this specimen. There are large supernumerary costal scutes on each side of the first vertebral (fig. 9), as in the other species of the genus and often in other members of the Baenidae. The supramarginal scutes form a row between the costals and the marginals and alternating with them. Although the full boundaries of the supramarginals have not been established, except in one instance, it is quite evident they have greater areal extent than in either of the described species, which has resulted in decreasing the size of the costal scutes. All the costal scutes are longer than broad, whereas in *B. pulchra* they are broader than long. Whether there was a supracostal scute present on the rear of the carapace, as in *B. pulchra* (Lambe, 1914, p. 14), cannot be determined in this specimen.

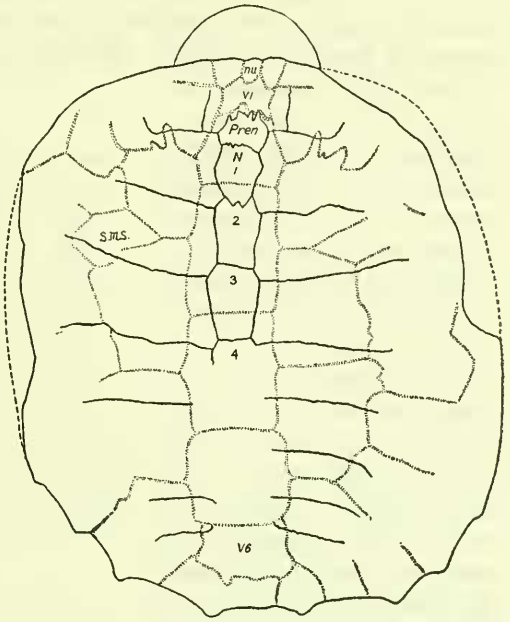

FIGURE 9.—Carapace of *Boremys grandis*. Type. U.S.N.M. no. 12979. N1, 2, 3, 4, Neurals 1 to 4; *nu*, nuchal scute; *pren*, preneural; *s.m.s.*, supramarginal scute; V1 and V6, vertebrals 1 and 6, respectively. One-sixth natural size.

The nuchal scute is longer than wide, measuring 14 mm on the free border and 18 mm fore and aft. In both *B. pulchra* and *B. albertensis* this scute is much wider than long.

There are six vertebrals in the type, and since this number is present in a second specimen (U.S.N.M. no. 12978), it apparently indicates it to be a constant character of this species, as in *Baena hatcheri* and *Chisternon undatum*. This extra vertebral has not been found in either *B. pulchra* or *B. albertensis*.

The three anterior vertebral scutes are relatively narrow for a baenid. The first vertebral is shorter than broad, whereas in *B. pulchra* it is nearly twice as broad as long, and in *B. albertensis* these dimensions are subequal. The form of the scutes is clearly shown in figure 9, and their dimensions are given in table 2.

The sixth vertebral is excluded from the posterior border by the intervention of supracaudal scutes, as in *Thescelus*. These two genera are the only baenids in which this vertebral does not extend to the border.

The plastron has a length at the center of 398 mm and a greatest width of about 280 mm. The bridge has a width fore and aft of 188 mm. The anterior lobe is 116 mm long and 143 mm wide at the base. The width diminishes gradually toward the front, the end being broadly rounded. The posterior lobe is 98 mm long and 134 mm wide at the base. The borders rapidly converge as far back as the anal-femoral sulcus; from this point backward to the end the sides are nearly parallel. The posterior end is broadly but shallowly notched at the middle.

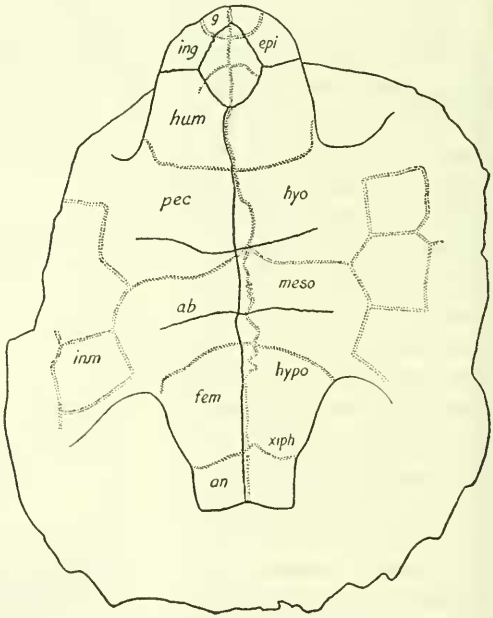

FIGURE 10.—Plastron of *Borcmys grandis*. Type. U.S.N.M. no. 12979. *ab*, Abdominal scute; *an*, anal scute; *epi*, epiplastron; *fem*, femoral scute; *g*, gular; *hum*, humeral; *hyo*, hyoplastron; *hypo*, hypoplastron; *ing*, intergular scute; *inm*, intermarginal scute; *meso*, mesoplastron; *pec*, pectoral scute; *xiph*, xiphiplastron. One-sixth natural size.

TABLE 2.—*Comparative measurements of vertebrals of* Boremys grandis

No.	Length		Width	
	U.S.N.M. no. 12979 (type)	U.S.N.M. no. 12978	U.S.N.M. no. 12979 (type)	U.S.N.M. no. 12978
	Mm	*Mm*	*Mm*	*Mm*
1	21	24	40	42
2	65	55	67	67
3	102	86	70	68
4	92+	90	78	71
5	82	74	85	86
6	46	----------	75	----------

The entoplastron is diamond-shaped, as in the other species of the genus (fig. 10). At the center the mesoplastrals meet on the mid line for 48 mm. These bones gradually widen from the center outward. The other sutures of the plastron are obliterated. The gulars meet on the median line for 26 mm; the intergulars for 23 mm; the humerals for 84 mm; the pectorals for 62 mm; the abdominals for 67 mm; the femorals for 90 mm; the anals for 45 mm.

There are four large inframarginal scutes on the bridge (fig. 10). *Boremys grandis* is at once distinguished from *B. pulchra* and *B. albertensis* by its much larger size and by the anterior lobe of the plastron being longer than the posterior. In the broadly rounded contour of the front of the carapace it resembles *B. pulchra* but is distinguished from *B. albertensis* with its pointed end.

Wiman (1933) briefly describes and figures a carapace from New Mexico, referred to *Baena nodosa*, which he says has the usual sculpture of that species but which has abnormal lateral and marginal scutes. The arrangement of these scutes strongly suggests the conditions found in the genus *Boremys* and indicates that perhaps this particular specimen may be a member of *Boremys*.

A second specimen (U.S.N.M. no. 12978), consisting of the right two-thirds of the carapace, and the plastron lacking the end of the posterior lobe, is also identified as pertaining to the present species. It was collected by N. H. Boss from the Kirtland in Brimhalls Wash, San Juan County, N. Mex., June 27, 1929. This specimen is slightly smaller than the type and displays some differences in the proportions of the scutal areas, but nothing more than might be expected in individual variations. In the general form of the carapace and plastron and in the character of the ornamentation of the carapace surface, the two specimens are in close accord.

Genus THESCELUS Hay

The genus *Thescelus* was established by Hay in 1908, and the species *T. insilens* from the Lance formation of Wyoming was selected as the genotype. At the same time a second species, *T. rapiens*, from the Ojo Alamo formation of New Mexico, was described. The genus was assigned to the family Baenidae. A specimen in the present collection records the second occurrence of *Thescelus* in the Kirtland formation, and since it displays characters distinguishing it from all described species, the name *T. hemispherica* is proposed for it.

The original characterization of the genus is no longer adequate, and I therefore propose the following amended diagnosis:

Front of carapace greatly shortened and excavated on the mid line. Carapace as wide or wider than long. Fifth vertebral excluded from posterior border by intervention of paired supracaudal scutes. Plastron extending strongly beyond the front border of the carapace; bridges broad, extending far forward. Buttresses feebly developed.

THESCELUS HEMISPHERICA, new species

FIGURES 11, 12; PLATE 16

Type.—U.S.N.M. no. 12818, consisting of the incomplete carapace and plastron. Collected by George F. Sternberg, 1929.

Type locality.—3 miles northeast of Hunter's Store (Bisti P. O.), San Juan County, N. Mex.

Horizon.—Kirtland formation, Upper Cretaceous.

Description.—The type specimen is an old individual as indicated by the coalesced sutures, none of which is longer visible. Although much of the peripheral region of the posterior half of the shell is missing, a small section of the posterior rim is preserved, and it permits an accurate measurement of the total length at the center as being 361 mm. The greatest width at about the middle is 370 mm. Since the first peripherals extend 13 mm in front of the bottom of the median excavation above the neck, the total length of the carapace is 374 mm. Thus the relative proportions of the carapace are similar to those of *T. insilens* from the Lance formation.

The form of the carapace resembles the other species in being broad, not greatly elevated, and having a broad median excavation for the neck. It is evidently not narrowed behind as in *T. insilens*. The one figured by Wiman from which the missing parts were restored, as shown in figure 11, has a shallow median excavation for the tail. The plastron extends far forward of the line of the carapace but otherwise resembles those of species of *Baena*.

The surface of the carapace is undulating, and outside the vertebral areas it is ornamented by a series of low, round-topped bosses and ridges. These are without regular arrangement and rather sparsely placed. Vertebral areas except first and fifth are smooth, these two being slightly roughened by low-lying elevations of irregular shape and size. There is indication of a low median keel along the middle of the carapace, which becomes more apparent toward the posterior end. (Pl. 16.)

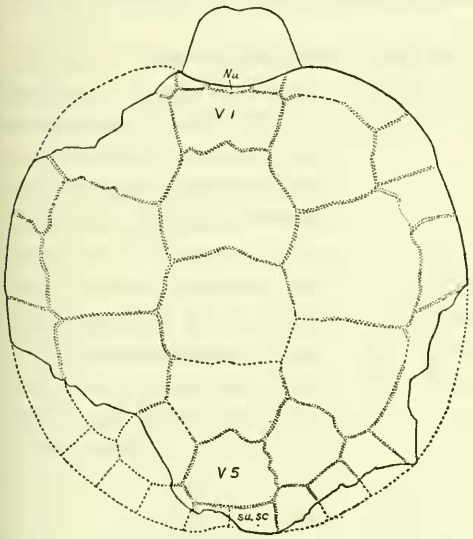

FIGURE 11.—Carapace of *Thescelus hemispherica*. Type, U.S.N.M. no. 12818, *nu*, Nuchal scute; *su.sc*, supracaudal scute; V1, V5, vertebrals 1 and 5, respectively. One-sixth natural size.

The scutal areas are distinctly marked on the shell and give the most complete information as to the arrangement of the scutes in this genus of any specimen yet obtained. The abbreviation of the front of the carapace has resulted in greatly reducing the size of the nuchal scute, which is very narrow anteroposteriorly, measuring 4 mm, whereas its width is 33 mm. This is the first time the presence of this scute has been recognized in this genus. Hay (1908, p. 96) thought it to be absent in *T. insilens*, and this region was not preserved in the type of *T. rapiens*. U.S.N.M. no. 8074, from the Lance formation of Wyoming, which is referred to *T. insilens* Hay, distinctly shows a large nuchal present.

TABLE 3.—*Comparative measurements of vertebrals of type specimens of two species of* Thescelus

No.	Length		Width	
	T. hemispherica	*T. rapiens*	*T. hemispherica*	*T. rapiens*
	Mm	*Mm*	*Mm*	*Mm*
1	41	50+	92	82
2	75	75	113	92
3	87±	81	115	92
4	66±	61	99	92
5	52	----------	78	86

The first vertebral is much shortened, and all are wider than long. The form of the vertebrals is clearly shown in figure 11, and their principal dimensions are given in table 3.

The fifth vertebral does not come to the posterior edge of the shell, as in the other members of the Baenidae, but is separated from it by paired supracaudal scutes, as in *T. insilens*.

The total number of marginal scutes cannot be determined from this specimen.

The plastron is large. The axillary notch is forward, being only 35 mm from the front of the carapace. The opening for the head and fore legs is therefore much restricted. The front lobe extends well forward beyond the front of the carapace. The anterior lobe has a length of 89 mm and is shallowly excavated on the mid line. The base is 115 mm wide, but it narrows rapidly toward the front, so that at the gular sulci the width is only 74 mm. The posterior lobe at the base is 135 mm in width.

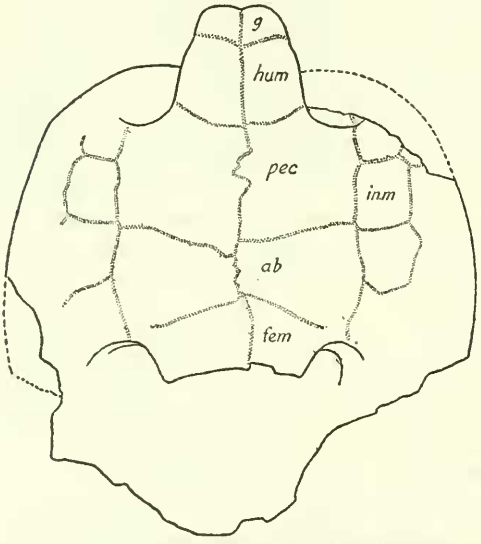

FIGURE 12.—Plastron of *Thescelus hemispherica*. Type. U.S.N.M. no. 12818. *ab*, Abdominal; *fem*, femoral; *g*, gular; *hum*, humeral; *in.m*, inframarginals; *pec*, pectoral scute. One-sixth natural size.

Anteroposteriorly the bridge has a width of 187 mm. From its inner end to the border of the carapace it is about 112 mm.

None of the sutures of the plastron is discernible.

The sulci are plainly impressed, and most of the scutal areas are well defined, as shown in figure 12.

No trace of intergular scutes was found, although present in *Thescelus insilens* Hay. The gulars are large and meet on the mid line for a distance of 28 mm; the humerals for 61 mm; the pectorals for 94 mm; and the abdominals for 44 mm. On the bridge there are four inframarginals that have been satisfactorily determined. The median longitudinal sulcus runs a somewhat irregular course as in many other baenids.

This species is at once distinguished from the Lance *T. insilens* by the bosslike ornamentation of the carapace, the relatively wider vertebrals, posterior border of carapace without constrictions, and

in having the nuchal less deeply excavated; and from *T. rapiens* of the Ojo Alamo by the lack of a median depression along the back, relatively wider vertebrals, and rough sculpture of the carapace.

In a recent paper Wiman (1933) has described a specimen from the Kirtland formation of New Mexico, which he refers to *Thescelus insilens* Hay, a Lance species. Compared with the type of *T. insilens*, the broadly rounded posterior border of the carapace at once distinguishes it from the narrowed, protrudent border of the Lance specimen, and this feature in conjunction with their different geological occurrence apparently indicates the incorrectness of its assignment.

In so far as comparisons can be made from descriptions and illustration, I find the Upsala specimen to be in close accord with *T. hemispherica* here described, to which the specimen is now referred. In figure 11 the missing posterior borders of the type have been restored after the Upsala specimen, which fortunately is well preserved, and serve to give us a complete picture of the carapace. The one discordant feature of this assignment appears to be that of the surface sculpture, of which Wiman says: "Die Oberfläche zeigt heir und da eine feine wenig charakteristische Skulptur, die an gerunzeltes Chagrinleder erinnert." There is no trace of this style of sculpture on the shell of the type of *T. hemispherica*, but it has the sculpture of *T. insilens* as described by Hay (1908, p. 95).

Parks (1933a) recently described a new turtle under the name *Baena fluviatilis* from the Belly River formation of Canada, which at my suggestion is now referred (Parks, 1933b) to the genus *Thescelus*.

The presence of paired supracaudal scutes posterior to the fifth vertebral, rear border of carapace unscalloped, and anterior lobe of plastron longer than posterior are all features foreign to the genus *Baena* and in accord with *Thescelus*. Unfortunately much of the anterior border of the type specimen is missing, so that a full diagnosis cannot be made, but in view of the features pointed out the assignment to *Thescelus* is probably correct.

This specimen is of much interest in recording the first occurrence of *Thescelus* in the Belly River formation and also in greatly extending its known geographic range. *T. hemispherica* from the Kirtland may be distinguished from *T. fluviatilis* by its smaller size and relatively narrower vertebrals, especially the fourth and fifth, and narrower anterior lobe.

Family DERMATEMYDIDAE

BASILEMYS NOBILIS Hay

FIGURES 13, 14; PLATE 17

A complete but somewhat crushed specimen (U.S.N.M. no. 11084) records for the first time the presence of the genus *Basilemys* in the Kirtland formation. It was collected by C. H. Sternberg in

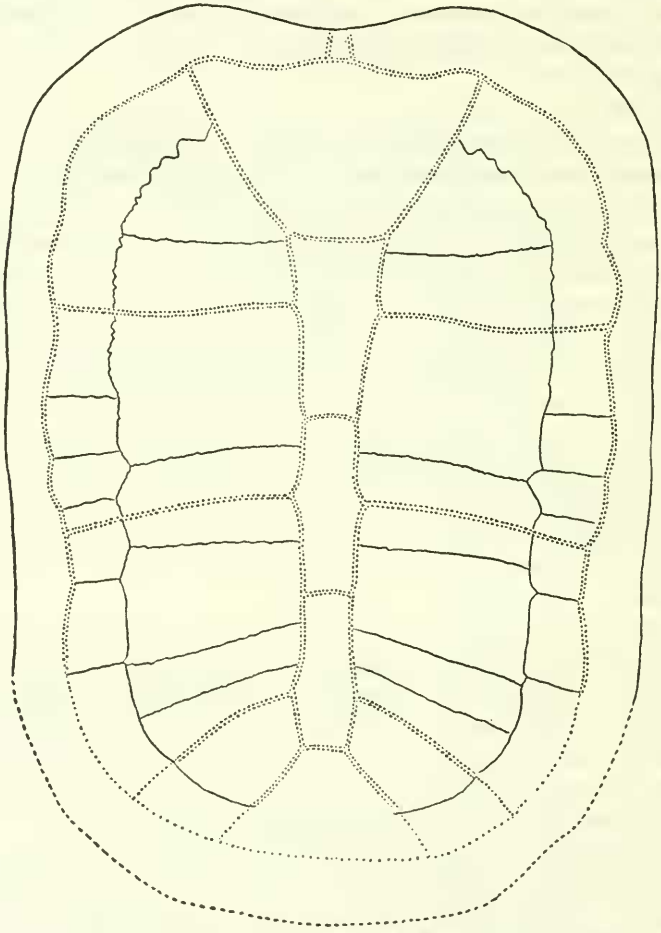

FIGURE 13.—Carapace of *Basilemys nobilis* Hay. U.S.N.M. no. 11084. One-sixth natural size.

1923 in Hunters Wash, 2 miles above Hunter's Store (Bisti P. O.), San Juan County, N. Mex.

This specimen is provisionally identified as pertaining to *Basilemys nobilis* Hay (1911, pp. 316–317), the type of which is said to have come from the overlying Ojo Alamo formation. The fragmentary character of the type of *B. nobilis* makes it exceedingly

difficult if not impossible to identify certainly other specimens with it. In view of the similar geographic and near geologic occurrence of the two specimens and the close agreement in structural details, so far as comparisons are possible, the assignment of the specimen to *B. nobilis* seems justified. If correct in this tentative identification, the specimen is of interest in contributing to a better understanding of this little-known species.

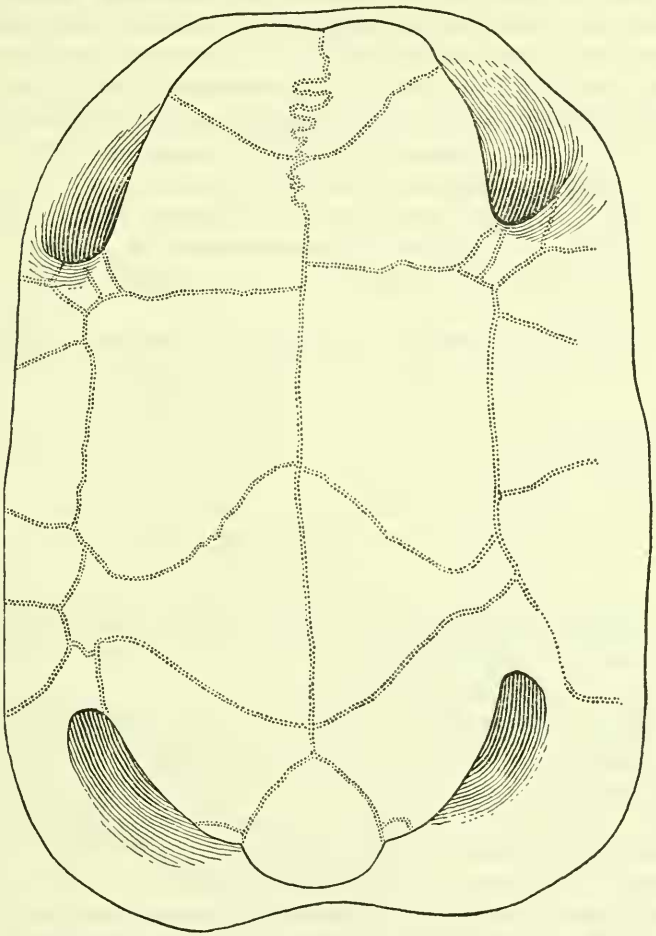

FIGURE 14.—Plastron of *Basilemys nobilis* Hay. U.S.N.M. no. 11084. About one-sixth natural size.

This specimen is about the same size as the type, the carapace at the center measuring 720 mm in length. The whole surface of the shell is sculptured with rough pyramidal elevations arranged in rows forming a pattern that is distinctive of the genus, but apparently alike in all described species.

The specimen is apparently an old individual, since most of the sutures are coalesced and the outlines of the individual elements can no longer be determined. The sulci outlining the dermal scutes can be traced and in most instances give a clear conception of their form and arrangement. The carapace has been badly crushed toward the right side, obscuring the width of the vertebrals (pl. 17).

The anterior border of the carapace is excavated above the neck, the free border at the center of the notch being about 48 mm thick. On each side of the mid line this border thins rapidly, soon forming an acute edge that thickens again before reaching the axillary notches. Behind the inguinal notches the border is slightly incomplete, but it was probably acute as in other species.

The nuchal scute is small, as in *B. sinuosa* Riggs, measuring 34 mm long and 16 mm wide. The vertebral scutes, except the first and fifth, are longer than wide, as shown in table 4.

TABLE 4.—*Measurements of vertebrals of* Basilemys nobilis

No.	Length	Width
	Mm	*Mm*
1	158	188
2	133	----
3	135	----
4	138	----
5	137	201

The costal scutes are of large size. The second has a length longitudinally of 145 mm and a height of 303 mm. They extend far below the costoperipheral suture.

The plastron is excellently preserved and at the center has a greatest length of 700 mm. The sulci although relatively shallow are all clearly defined, and the form and proportions of the scutal areas have been certainly determined, as shown in figure 14. The sutures as on the carapace are obliterated. The bridge of the plastron measures 360 mm in width anteroposteriorly. The lobes are relatively short. The anterior lobe is 318 mm wide at the base and 152 mm long. Its sides turn in gradually toward the median line as far as the gular-intergular sulcus, from which it projects forward from the rest of the curvature of the lobe, forming a wide, prominently projecting, epiplastral beak much as in *B. praeclara* Hay. At the base this beak has a greatest width of 133 mm. The greatest thickness is 59 mm.

The posterior lobe is about 118 mm long and 310 mm wide at the base. The lobe appears to have been broadly rounded behind, as in *B. variolosa.*

The gular scutes are greatly reduced in size and are widely separated by a pair of large intergulars, which meet on the median line for a distance of 100 mm. In the presence of greatly reduced gulars this species resembles *B. variolosa.* The humeropectoral sulcus is at first directed backward from the axillary notch for 45 mm, then turns abruptly forward and inward to the median line. The humeral scutes at the center measure 23 mm in length. The pectoral scutes are narrow at their outer ends, as in *B. variolosa.* At the narrowest part they measure 43 mm, at the center 208 mm. The abdominal scutes are large, measuring 143 mm along the mid line; the femorals 100 mm, and the anals 117 mm.

The scutes covering the bridge are separated from the plastral scutes by a nearly straight sulcus running from the axillary to the inguinal notch. As pointed out by Hay (1911) only the most anterior and most posterior are inframarginals, the intervening ones being marginals. The absence of inframarginals constitutes one of the important distinctive features of the genus *Basilemys.*

In size and form of the carapace and in the proportions of the dermal scutes, this species has its nearest resemblances in *B. variolosa.* The chief distinction lies in the form and development of the epiplastral beak. It differs in being broad and protruding, instead of roundly pointed and nonprotrudent, as in *B. variolosa.* From *B. sinuosa* and *B. praeclara* it is distinguished by the greatly reduced gulars that are not in contact on the median line.

A specimen recently described by Wiman (1933, pp. 25–30) from the Fruitland shales of New Mexico is likewise referred to this species. The form of the anterior lobe has the shape of *B. variolosa* Cope, which differs considerably from the lobe of the Kirtland specimens previously described. If these two specimens pertain to the same species, the difference observed may be sexual, in which event the National Museum specimen is probably the male, the Upsala specimen the female.

ADOCUS BOSSI Gilmore

Four additional specimens pertaining to *Adocus bossi* were obtained by the 1929 expedition. These (U.S.N.M. nos. 12838, 12842, 12982, and 12983) are nearly complete shells and except for being flattened are in a good state of preservation. All were found close together in SW¼, T. 24 N., R. 13 W., San Juan County, N. Mex. A fifth specimen (U.S.N.M. no. 11326), which appears to be referable to this species, was collected by C. H. Sternberg in 1923 on Meyers Creek, San Juan County, N. Mex., from the Fruitland formation.

Family TRIONYCHIDAE

ASPIDERETES OVATUS, new species

FIGURE 15; PLATE 18, FIGURE 1

Type.—U.S.N.M. no. 12986, consisting of the carapace lacking a portion of the anterior border and fragmentary parts of the plastron. Collected by C. W. Sternberg, 1929.

Type locality.—7 miles northwest of Brimhall's Store, San Juan County, N. Mex.

Horizon.—Kirtland formation, Upper Cretaceous.

Description.—The specimen selected as the type lacks the nuchal and portions of the right first costal, but otherwise, although much checked and slightly distorted, the carapace is quite complete.

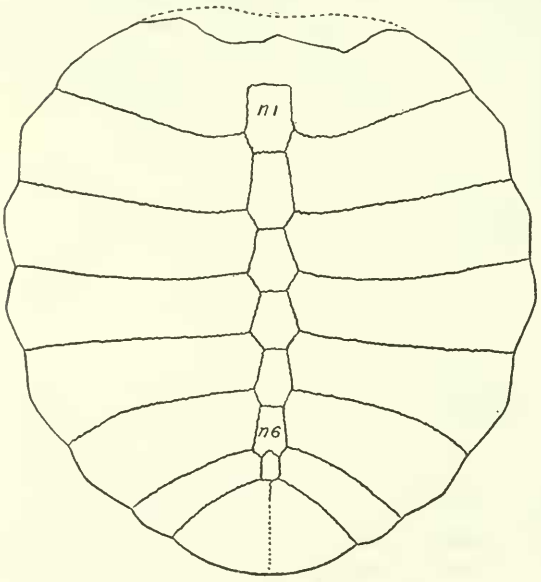

FIGURE 15.—Carapace of *Aspideretes ovatus*. Type. U.S.N.M. no. 12986. N1, N6, Neurals 1 and 6, respectively. One-fourth natural size.

The carapace is oval, with the broader end forward of the middle. The rear end is broadly pointed. The shell has a greatest estimated length of about 310 mm and a greatest width of 283 mm.

The sculpture of the carapace consists of shallow, rounded pits, separated by ridges whose summits are flat topped. Toward the outer margins of the shell the pits tend to arrange themselves in rows parallel with the adjacent border (pl. 18, fig. 1). In the central area the pits are irregular in placement and less deeply impressed. A second specimen (U.S.N.M. no. 12987), which may be referred to this species, shows the central area to be smooth and almost devoid of pitting. There are a few spots on the central part of the type, showing a similar condition. A narrow band crossing the outer ends of the costals is free of pitting, as are the beveled ends. The sculpturing is distinctive and will serve at once to distinguish this species from the other Upper Cretaceous trionychids of this region.

There are seven neurals of the usual coffin shape, the seventh being much reduced in size, subelliptical in form. Table 5 gives the dimensions of these bones. The preneural cannot be differentiated.

TABLE 5.—*Measurements of neurals of* Aspideretes ovatus

No.	Length	Width
	Mm	*Mm*
1	36.5	[1] 26
2	36	26
3	32	25
4	30	23
5	27	18
6	24	16
7	14.5	9.5

[1] Estimated.

The nuchal is missing, but it quite evidently protruded prominently from the front border. The form of the costals is well shown in figure 15. The eighth pair of costals meet on the median line. It is also possible that the seventh pair may meet on the median line for a portion of their width.

In the ovate form of the carapace this species has a resemblance to *Aspideretes vegetus* but is distinguished by differences in the sculpture and presence in the latter of numerous longitudinal welts on the carapace.

ASPIDERETES VORAX Hay

FIGURE 16; PLATE 18, FIGURE 2

A specimen (U.S.N.M. no. 12988) consisting of the anterior third of the carapace is identified as belonging to *Aspideretes vorax* Hay. The assignment of any specimen to this species must to a certain extent be provisional because of the scanty nature of the type, which consists of a nuchal and costal fragments. The close resemblances in size and form of the present nuchal to that of the type, however, seem to leave little chance of their not being cospecific. If this assignment is correct, this specimen is of no little interest in contributing to a better understanding of this little-known species.

The specimen was collected by G. F. Sternberg from the Kirtland formation, 3 miles northeast of Hunter's Store (Bisti P. O.), SW¼, T. 24 N., R. 13 W., San Juan County, N. Mex., in 1929.

U.S.N.M. no. 12988 consists of the almost complete anterior third of the carapace anterior to the suture for the fourth costal. The front of the carapace is quadrangular, slightly excavated, and curved upward over the neck. The nuchal projects but slightly beyond the

forward margin. It measures 204 mm from end to end in a straight line and 210 mm over the curve. The same dimensions of the type nuchal are 200 and 215 mm, respectively. The width at the mid line is 45 mm, the same as in the type. Its greatest thickness is 14.5 mm, whereas the type has a thickness of 15 mm. The anterior border is steeply beveled to a sharp edge; this beveled surface without sculpturing is traversed by a faint median sinus. The posterior border is hollowed out at the center for the articulation of the preneural. This excavation has a width of about 38 mm.

This turtle is a large one, having a transverse diameter at the suture between the third and fourth costals of 482 mm. The outer

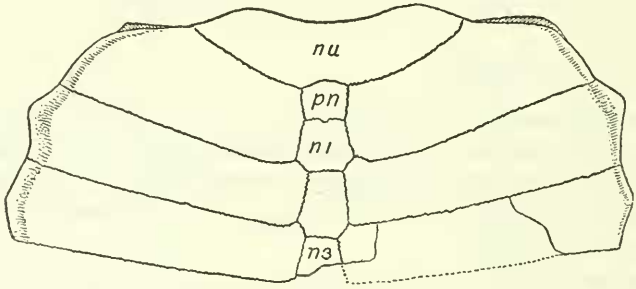

FIGURE 16.—Carapace of *Aspidcretes vorax* Hay. U.S.N.M. no. 12988. *nu*, Nuchal; *pn*, preneural; *n1* and *n3*, neurals 1 and 3, respectively. One-sixth natural size.

end of the first costal contributes to the formation of the anterior and lateral borders of the shell, as shown in figure 16. It has a greatest width of 82 mm; the second and third each measure 66 mm across their outer ends. The outer ends of the costals are beveled off to a sharp lower edge. This edge is without sculpture. Through the rib the costals have a thickness at their outer ends of 15 mm, at the proximal end 8 mm.

The preneural is quadrangular, being slightly wider than long. Anteroposteriorly it measures 38 mm. The neurals are of the usual coffin shape; the first is 38 mm long, the second 51 mm.

The sculpture of the carapace consists of a network of round-topped ridges surrounding shallow pits. On the outer halves of the costals they tend to arrange themselves in rows running parallel with the adjacent border of the carapace. On the nuchal and the proximal portions of the costals the pits are irregular but evenly distributed. On the neural surfaces and in places on the upper ends of the costal, they are sparsely distributed, in some spots smooth and devoid of ornamentation. The costals have a narrow band along the intercostal sutures formed by a series of low ridges set at right angles to the suture.

As pointed out by Hay (1908, pp. 496–497), *A. vorax* differs from *A. fontanus* and *A. austerus* in having the anterior border of the nuchal beveled instead of clipped off at right angles to the upper surface. The form of the outer end of the first costal also serves to distinguish *vorax* from *austerus*.

U.S.N.M. no. 6550, referred to in a previous paper (Gilmore, 1916) as questionably identified by Hay as *Aspideretes vorax*, can now quite certainly be dismissed from further consideration in that connection. The thinner nuchal and different shape of the first costal, which does not participate in the formation of the anterior border of the carapace, appear sufficient to exclude it from this species.

Class PISCES

Family SQUATINIDAE

FIGURE 17

The family of angelfishes, or monkfishes, appears to be represented in the Kirtland formation by a single tooth (fig. 17) found associated with scales of *Lepisosteus* and teeth of *Myledaphus* in SW¼, T. 24 N., R. 13 W., San Juan County, N. Mex. The tooth has a conical crown without lateral denticles with a depressed root, much of which is missing. If this identification is correct, the specimen is of interest as being the first representative of the Squatinidae to be found in the Cretaceous of North America.

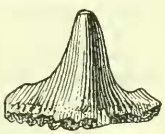

FIGURE 17.—Tooth of squatinid. U.S.N.M. no. 13655. Internal view. Twice natural size.

THE KIRTLAND FAUNA AND ITS GEOLOGICAL AGE

Owing to increased activity in collecting, our knowledge of the Kirtland fauna has been greatly advanced during the past few years. This work has resulted in the discovery of new forms and also in the recovery of well-preserved specimens of species previously known only from meager materials. These specimens permit of a better diagnosis than was previously possible, resulting in a more accurate estimation of the faunal stage represented by the Kirtland formation. The revised faunal list is as follows:

DINOSAURIA:

Hadrosauridae:

Kritosaurus navajovius Brown.
Parasaurolophus tubicen Wiman.

Ceratopsidae:

Pentaceratops sternbergii Osborn.
Pentaceratops fenestratus Wiman.
Chasmosaurus sp.

DINOSAURIA—Continued.
Deinodontidae:
Gorgosaurus sp.
Nodosauridae:
Armored dinosaurs.
CHELONIA:
Pleurosternidae:
Neurankylus baueri Gilmore.
Baenidae:
Baena nodosa Gilmore.
Baena ornata, new species.
Baena sp.
Thescelus hemispherica, new species.
Boremys grandis, new species.
Dermatemydidae:
Basilemys nobilis Hay.
Adocus bossi Gilmore.
Adocus kirtlandius Gilmore.
Trionychidae:
Plastomenus robustus Gilmore.
Plastomenus sp.
Aspideretes ovatus, new species.
Aspideretes vorax Hay.

Dinosaurian reptiles were the predominating vertebrates of this time, and they afford the most reliable information for correlation with those Upper Cretaceous faunas found elsewhere in North America. Representatives of four families have now been recognized: Deinodontidae, Hadrosauridae, Ceratopsidae, and Nodosauridae. The Deinodontidae are represented by a dentary not distinguishable from the corresponding bone of *Gorgosaurus*, known elsewhere only from the Belly River formation. That other members of this family are present is indicated by fragmentary remains none of which is generically identifiable. The Hadrosauridae are represented by the genera *Parasaurolophus* and *Kritosaurus*, both of which occur elsewhere only in the Belly River of Canada; the Ceratopsidae by the genus *Pentaceratops* and a chasmosaurid, the latter also a Belly River form, but its occurrence in the Kirtland needs additional verification before we can be positive of its assignment. Lull (1933) regards the genus *Pentaceratops* as having a more advanced stage of horn development than is found among the Belly River ceratopsians and finds its nearest complement in those of the Edmonton. In the light of the recently described *Chasmosaurus kaiseni* (Brown, 1933), from the Belly River, with tall brow horns and well-developed nasal horn, it would seem to me this conclusion no longer applies.

The evidence furnished by the known Dinosauria is overwhelmingly in favor of regarding the Kirtland formation as equivalent to the Belly River of Canada, as previously suggested by Brown and

Gilmore. Additional evidence favoring such a conclusion is found in the turtles. The Chelonia are now represented by 8 genera and 11 species, all based on adequate specimens. Six of the eight genera are common to the two formations. The genus *Boremys* has not been found elsewhere. *Thescelus* occurs elsewhere in the Lance and *Neurankylus* only in the Benton. *Baena* and *Basilemys* enjoy a wide geological distribution and offer no correlative evidence.

The Crocodilia and Pisces are too fragmentary to be of assistance.

The Upper Cretaceous age of the Kirtland formation is accepted by all, but some differences of opinion exist as to the particular part of the Upper Cretaceous with which it should be correlated.

On the basis of the invertebrate faunas, Drs. T. W. Stanton and J. B. Reeside, Jr., are of the opinion that it is synchronous with the Edmonton, a viewpoint accepted by Prof. Lull (1933) in his revision of the Ceratopsia. Brown, in his first study of the Ojo Alamo, which at that time included the Kirtland, expressed the opinion that it was comparable to the Edmonton. Upon the discovery of *Kritosaurus*, however, Brown (1914) altered his idea to make it synchronous with the Belly River, a viewpoint to which I later gave support (Gilmore, 1916).

In the light of this more recent study of new vertebrate materials, it is my conclusion that the Kirtland and Belly River are equivalent in age. Whether distinct faunas are to be found in the several Upper Cretaceous formations occurring in this area cannot yet be established. Such evidence as there is appears to indicate that genera and even species continue through from the Fruitland to the Ojo Alamo.

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